

## **Appendix 2-E**

### **Summary of Requirements for Operations and Maintenance Facilities**



# California High-Speed Train System



## Summary of Requirements for O&M Facilities

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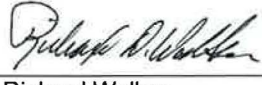


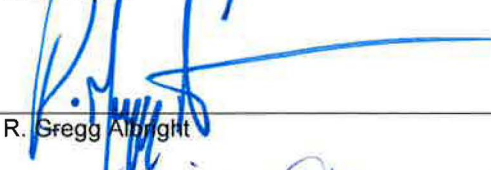



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Note: Signatures apply for the latest revision as noted above.

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## 1.0 INTRODUCTION

### 1.1 PURPOSE

The purpose of this memorandum is to develop a comprehensive listing of requirements for O&M facilities throughout the Phased Implementation of the California High-Speed Train (CHST) System. This memorandum describes the characteristics of the facilities: dimensions, overall acreage requirements, special environmental considerations, and considerations for interface to the rest of the CHST System. Environmental, business, commercial, and economic impacts of the facilities on the local communities will be described. The goal is to better inform at the preliminary design phase the decisions associated with engineering and environmental clearance.

### 1.2 SOURCE DOCUMENTS

Source documents used to develop this memorandum include:

- Tech Memo 5.1 *Terminal and Heavy Maintenance Facility Guidelines*, 8/25/09
- Tech Memo 5.3 *Summary Description of Guidelines for: Heavy Maintenance Facility (HMF), Terminal Layout/Storage & Maintenance Facilities& Right-of-Way Maintenance Facilities*, 8/25/09
- Directive Drawing TM 5.1-A *Heavy Maintenance Facility (HMF) Concept Plan*, 5/29/09
- Directive drawing TM 5.1-H *MOI Yard*, 8/30/11
- Directive Drawing TM 5.1-I *MOI Siding*, 8/30/11
- *Concept of Operations*, Rev 3, 5/24/12
- *Maintenance of Infrastructure – Concept and Requirements*, Rev0, 6/30/11
- *Rolling Stock Maintenance Plan – Preliminary Draft*, Rev4, 6/26/12
- *Environmental Methods, Version 5, 2012*

The information derived from these source documents has been updated, where appropriate, to reflect the phased-implementation strategy identified in the California High-Speed Rail Authority's 2012 Business Plan.

### 1.3 ASSUMPTIONS

- The phased implementation strategy for blended service, as identified in the California High-Speed Rail Authority's 2012 Business Plan, will be implemented as follows:
  - Initial Operating Segment (IOS): Merced to San Fernando, year 2022
  - Bay to Basin (B2B): San Jose to San Fernando, branching off from the original Initial Operating Segment line near Chowchilla, south of Merced, year 2027
  - Phase 1 Blended Service (P1B): San Francisco to Los Angeles, year 2029
- Equipment will be operated and maintained in configurations of 660-foot trainsets, potentially operated in double sets of 1320-foot total length.
- Fleet size will grow according to the following Blended Service Plan schedule and as described in the *Concept of Operations*, Rev 3, 5/24/12. Trainsets listed below indicate equipment need to provide service in the 5<sup>th</sup> year of segment operation:
  - IOS: 27 trainsets
  - B2B: 50 trainsets
  - P1B: 72 trainsets
- The rolling stock fleet includes a nominal 10% margin for trainsets identified as a "spare ratio" and positioned for maintenance/inspection backup, hot standby for breakdowns, and seasonal or other service demand fluctuations. Storage space for accommodating reserve equipment is accounted for in each facility.
- Phase 1 Blended Service requirements identified in this memo were developed to support the ridership forecasts and service plan of the 2012 Revised Business Plan. A new service plan will be required to support the Authority's 2014 Business plan which may affect fleet size and therefore affect



the “footprint” of the vehicle maintenance facilities. It is recommended that current “footprints” for facilities be maintained until such time as those service plans are adopted.

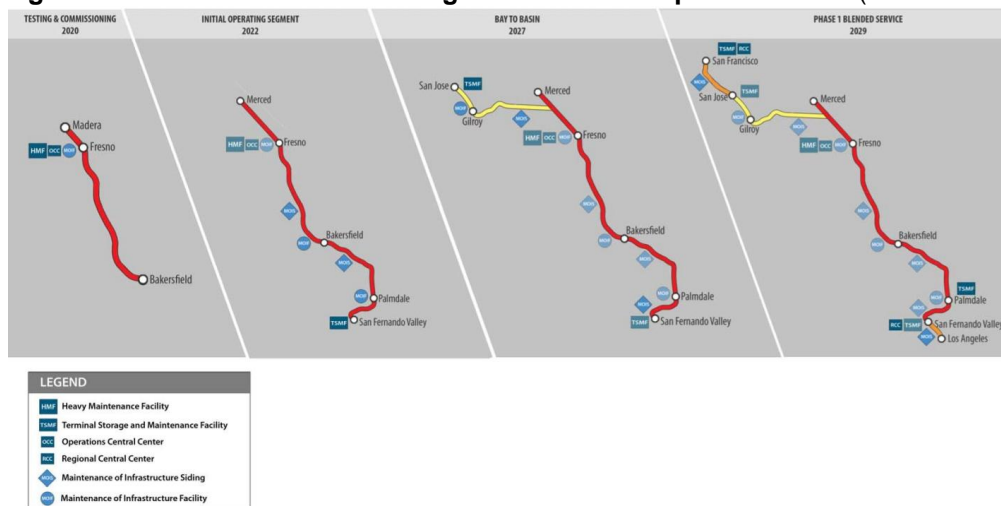
- Equipment maintenance will follow a 5-level hierarchy of functions:
  - Level I – Daily inspections, pre-departure cleaning and testing
  - Level II – Monthly inspections
  - Level III – Quarterly inspections, including wheel-truing and ATC system testing
  - Level IV – Annual inspections, including underside/bogie inspection
  - Level V – Overhaul, component change out, commissioning and de-commissioning
- Yard tracks are designed to accommodate two 660 foot trainsets each. Yard capacity for trainsets is estimated to be at 80% of total possible space in the yard, in order to provide room to maneuver the equipment to and from the shop areas and the main track...
- Shop tracks are designed to accommodate a minimum of one trainset each. Shop capacity for holding/storing trainsets is set at 50% of total possible space in the shop area, in order to accommodate various shop track functionalities and to provide room to maneuver equipment.
- The rolling stock life cycle is 25-30 years, including a “heavy” overhaul. Bogey overhaul will occur at 600,000 mile intervals, equating to approximately 3 year cycles and in advance of the heavy overhaul. Heavy overhaul cycles (Level 5) occur at 3-5 year intervals in the rolling stock life cycle, staggered to work through the fleet in stages...
- Impacts to environmental resources will be avoided and/or minimized to the extent feasible in the locating of O&M facilities.

## 2.0 O&M FACILITIES

Operations & Maintenance (O&M) facilities are required to support the development and operation of the California High-Speed Train (CHSTS) System through the Phase 1 Blended Service stage of the project; that is, the service that operates high-speed trains from San Francisco and Merced on the north to Los Angeles on the south. The O&M facilities required to support Phase 1 Blended Service are the Heavy Maintenance Facility (HMF), Terminal Storage and Maintenance Facilities (TSMF), Maintenance of Infrastructure Facilities (MOIF), Maintenance of Infrastructure Sidings (MOIS), Operations Control Center (OCC), and, if required, Further explanation of these facilities will be detailed later in this memo.

It should be noted that the siting of the O&M facilities has not been determined at this time. For illustrative purposes only, hypothetical locations of each facility are shown in Figure 1 and Table 1 for the progression of the phased development of the Project.

**Figure 1 – O&M Facilities throughout Phased Implementation (For Illustrative Purposes Only)**



Size requirements for the O&M facilities are summarized in Table 1.

**Table 1 – Summary of O&M Facilities** (For Illustrative Purposes Only)

Facility	General Specification			Facility Locations and Trainset Space Requirements in Each Phase				
	# Tracks	Yard Capy.	Acreage	Locations	Testing / Commission Year 2020	IOS Year 2022	Bay to Basin Year 2027	Phase 1 Blended Year 2029
Fleet Size	--	--	--	--	20+	20-27	50 by the year 2029	72 by the year 2034
HMF	13 yard 10 service/ shop tracks	22 trainsets	169 +/-	HMF (Central Valley)	20 Layup  Level I-IV Maintenance	12 Layup 5 Reserve  Level I-IV Maintenance	11 Layup 5 Reserve  Level I-V Maintenance	10 Layup 6 Reserve  Level I-V Maintenance
TSMF Maint. Levels 1-3	10 yard 8 service/ shop tracks	16 trainsets (SFO)	100 +/-	San Francisco	N/A	N/A	N/A	8 Layup 4 Reserve  Level III Maintenance
	15 yard 8 service/ shop tracks	24 trainsets (SFV)	100 +/-	SFV/ Los Angeles	N/A	10 Layup 2 Reserve  Level III Maintenance	19 Layup 2 Reserve  Level III Maintenance	15 Layup 4 Reserve  Level III Maintenance
TSMF Maint. Levels 1-2	8 yard 2 service/ shop tracks	Varies	42 +/-	San Jose/ Gilroy	N/A	N/A	15 Layup 2 Reserve  Level II Maintenance	9 Layup 4 Reserve  Level II Maintenance
				Palmdale	N/A	N/A	N/A	8 Layup 4 Reserve  Level II Maintenance
MOIF	6 yard, 1 siding	8150'	28+/-	Gilroy			X	X
				Fresno	X	X	X	X
				Shafter	X	X	X	X
				Palmdale		X	X	X
MOIS	1 siding, 1 tail	675'	4+/-	Rdw. City				X
				Los Banos			X	X
				Hanford	X	X	X	X
				Tehachapi		X	X	X
				Rosamond		X	X	X
				Sylmar			X	X
				Glendale				X

Based on a service design driven by the CHSTS ridership demand forecast, an operating plan was developed to define train schedules and estimate the number of trainsets for the CHSTS rolling stock fleet. In order to support the commissioning activities, layup/storage and maintenance program requirements (Levels I, II, III, IV, V), and ultimate retirement for this estimated fleet size, concepts were developed for the daily Terminal Storage and Maintenance Facilities (TSMF) and a Heavy Maintenance Facility (HMF) with the requisite tracks and shop buildings. In addition, right-of-way maintenance requirements were examined, and a description of a “typical” Maintenance of Infrastructure Facility (MOIF) configuration was developed and recommendations for approximate locations along the high-speed train system alignment were identified.



Preliminary guidelines and criteria applicable to the design of the TSMF, HMF and MOIF have been prepared (Tech Memo 5.1). The size and configuration of these facilities were estimated based on defining the capabilities and functional requirements necessary to support the activities critical to efficiently maintaining and safely operating the CHSTS rolling stock fleet and physical plant. These capabilities and requirements were largely derived from a review of best practices and programs used on similar high-speed train systems around the world, including France, Korea, Taiwan and Japan.

## 2.1 HEAVY MAINTENANCE FACILITY

The Heavy Maintenance Facility (HMF) is a key element of the California High-Speed Train system. Locating the HMF in the central part of the system is critical to the efficient implementation of operating and equipment maintenance plans.

Functional requirements of the HMF site include: receipt, setup and commissioning of equipment; heavy maintenance and repairs; and decommissioning of equipment at end-of-service-life milestones. These activities require 14 storage/yard tracks 1650 feet long with 19.5 foot track centers, each capable of holding two complete trainsets, plus two run-around tracks to move from one end of the facility to the other. Table 2 shows the basic physical requirements for the HMF.

**Table 2 – Heavy Maintenance Facility Physical Requirements**

Yard Tracks	Servicing / Shop Tracks	Morning Train Starts at Highest Volume	Est. HMF Length (not including transition tracks)	Est. HMF Width (at widest point)	Estimated Acreage
13	10	12 (IOS)	7500' +/-	1200' +/-	169 +/-

Setup of equipment includes space to accommodate the receipt, assembly, testing, acceptance and commissioning of up to 27 trainsets prior to the start of IOS revenue service. The shop facility requirements for setup and commissioning will be based upon the trainset manufacturer's recommendations. The HMF must be adjacent to the main track alignment in order to facilitate efficient, effective testing of equipment: must be near to repair facilities in case of malfunction, technicians must have ready access to equipment and facilities, and distance traveled for deadhead moves should be minimized in order to maximize the effective use of the testing windows.

The HMF will support Level I through Level V maintenance activities, the only such facility in the CHST System, although Level V maintenance activities do not begin until 3-5 years into the equipment life cycle (midway into the B2B phase). Level I-III maintenance activities will require 4 inspection/service tracks, 1 wheel-truing track with drop table, and 1 track equipped with lift equipment to accommodate an entire trainset intact. All servicing tracks for Level I-III maintenance will be accessible from the outside on both ends, allowing for pass-through movement of the equipment.

Level IV-V maintenance activities include the lifting of equipment for underside inspection, heavy repairs, major component change-out, and modifications or upgrades of equipment. To support these activities, the HMF shop facilities will include 4 heavy maintenance tracks, all with interior access capable of enclosing an entire trainset. The end result is a total of 10 tracks inside the shop building. The shop facilities will be segregated into individual functional areas including run-through servicing and inspection, running repairs, truck/bogie shop, component cleaning, brake shop, electronics shop, HVAC unit repair, pantograph repair, battery storage and repair, a paint shop, and a wheel shop that includes wheel truing capability.

The functions of the HMF evolve as the CHST System matures. Initially, during the Testing/Commissioning phase prior to the IOS startup phase, the HMF supports all setup, final assembly and integration of systems, testing/commissioning and maintenance of the rolling stock for the system with the potential to layup the entire fleet if necessary. Two shop tracks will be dedicated to setup of new



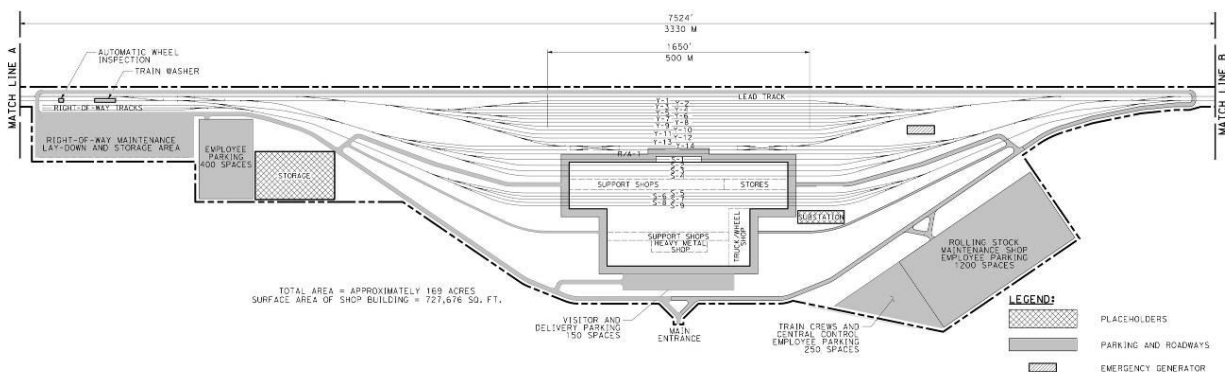
equipment. These tracks will evolve into functioning service tracks as the revenue service levels mature, requiring the addition of two new setup tracks within the shop building.

In the Initial Operating Segment phase the HMF will support operations service levels for the northern half of the system through the dispatch of serviced deadhead trainsets to the Merced and Fresno terminals, approximately 12 train starts at the start of each revenue day. Supporting the revenue service includes cleaning and servicing activities between runs, pre-departure inspections and testing, and train wash and wheel defect detection. A Terminal Station Maintenance Facility will also be located at San Fernando to support the southern half of the system. In addition, the ability to store up to 5 spare trainsets will be accommodated at the HMF during the IOS phase.

During the Bay to Basin and later phases of operation the HMF transitions to a more traditional maintenance role of centralized maintenance and repair. Minimal daily service is dispatched from the HMF during these phases due to the greater distances to the outer terminals (San Jose and San Fernando, eventually San Francisco and Los Angeles). The morning trains starts supported by the HMF are estimated at 11 in the Bay to Basin phase and 10 for the Phase 1 Blended Service phase, primarily for Merced and Fresno train starts. Reserve trainset storage accommodations include up to 5 in the Bay to Basin phase and 6 in the Phase 1 Blended Service phase. The Phase 1 Blended Service phase also includes storage capacity to satisfy the need to accept and commission additional equipment to support Phase 2 Full Build service levels, plus acceptance and commissioning of new equipment while at the same time decommissioning older equipment at end-of-service-life milestones.

The layout of the HMF in relation to the main tracks will have a significant effect on HMF functionality and the flow of trains on the main tracks. The recommended HMF configuration that maximizes main track capacity and minimizes the effects on the revenue service plan includes direct main track access achieved through double-ended yard leads to facilitate movements both north and south without changing direction, grade separated flyovers to access the main track opposite the HMF without affecting main track traffic, 60 MPH interlockings including universal crossovers (approximately 1000 feet long, these must be located in tangent sections, preferred to be at-grade and on relatively level gradient), and 1700 foot transition tracks to reduce speed to/from stop and transition the automatic train control system. The result is an overall estimated minimum footprint of approximately 169 acres. Figure 2 shows the conceptual layout for the HMF.

**Figure 2 – Heavy Maintenance Facility Concept Plan**



Less optimal configurations may include at-grade or “flat” interlockings, turnout speeds in interlockings of less than 60 MPH, and shorter transition tracks. Solutions to these less optimal conditions may include additional deadhead miles or time in order to avoid delays to revenue trains by non-revenue movements, additional operating crews in order to expedite reverse movements on the main track, and alterations to maintenance scheduling to accommodate the arrival of non-revenue trains at non-peak hours of operation. The operational and cost impacts of these less than ideal configurations must be analyzed further in order to evaluate the trade-off of the additional yearly O&M costs versus the increased capital construction costs and the potential increase in environmental impacts.



Other O&M facilities that could be co-located with the HMF include the Operations Control Center and a Maintenance of Infrastructure Facility. Locating these facilities as an integral part of, or adjacent to, the HMF could allow for better coordination and utilization of operations systems and assets during the following activities:

**Commissioning–**

- The HMF must be sited adjacent to the main track.
- Maintenance buildings, dispatch sites and training facilities should be located in the HMF at this juncture to support commissioning.
- Personnel for Train Control, Communication, SCADA and other systems must be trained and those systems tested prior to Trainset commissioning.
- Tactical discussion and debriefing will be necessary as the systems are placed on line. Central location will be important for the successful integration of multiple cross functional systems
- Vendors will better be able to supervise and staff systems integration effort for warranty and operations testing

**IOS Operations**

- OCC and Operation (MOI/MofE) central location will make for better strategic response in the event of a service disruption by making the discipline leaders available for face to face coordination.
- Training and on the job experience will be easier and cheaper to accomplish by the existence of a co-located facility. Split facilities will result in additional training costs to the operator.

It should be noted though that locating these facilities separate from the HMF will not necessarily introduce negative impacts that could not be effectively managed/mitigated. The individual requirements for these facilities will be discussed in further detail in Sections 2.3 and 2.5 of this memo.

## 2.2 TERMINAL STORAGE AND MAINTENANCE FACILITY

Terminal station locations can be supported by a Terminal Storage and Maintenance Facility (TSMF) for the purpose of supplying inspected and serviced trainsets at the start of the revenue day. It should be noted though that these facilities are based on the current implementation phases of the project. They may not be necessary depending upon the service plans and phasing that could be adopted. As an example an incremental phasing step may be to operate a temporary terminus at Palmdale as a midpoint to the ultimate IOS. Should this be the case it may not be necessary to have a TSMF at Palmdale because the equipment could be maintained from the HMF providing there were adequate storage tracks at the Palmdale terminus. Terminal station locations will evolve as the system matures through the operating service segments as follows:

- Initial Operating Segment: San Fernando
- Bay to Basin: San Jose (Gilroy) and San Fernando
- Phase 1 Blended Service: San Francisco, San Jose (Gilroy), Palmdale, and Los Angeles (San Fernando)

TSMF locations will be sized to support either Level II or Level III maintenance activities. These activities include cleaning and servicing activities between runs, pre-departure inspections and testing, and monthly inspection and maintenance activities. Level III functionality includes train wash and wheel defect detection facilities.

The TSMF sites will be sized to support the level of daily revenue service dispatched by the nearby terminal at the start of each revenue service day, resulting in a two-tiered TSMF design. San Fernando and San Francisco TSMFs will support major end terminal operations at San Francisco and Los Angeles respectively, resulting in larger yard capacity requirements and the need for Level III servicing capability. The San Francisco and San Fernando TSMFs will include up to 15 and 10 layover and storage tracks respectively, each 1650 feet long with 19.5 foot track centers and capable of holding two complete trainsets, with a total estimated footprint of approximately 100 acres. Gilroy and Palmdale will ultimately support interim terminal operations, resulting in slightly smaller yard capacity requirements and the need for Level II servicing to prepare trains for revenue service. The Gilroy and Palmdale TSMFs will include 8



yard tracks and 2 shop tracks with an estimated footprint of 42 acres. If the San Fernando Valley TSMF is sized larger to accommodate more layout and servicing functions, the Palmdale TSMF can then be sized smaller accordingly. (It should be noted that even if all of Palmdale TSMF functions could be accommodated at San Fernando Valley there will still be the need, however, for a MOI facility in the Palmdale area). Table 3 shows the basic physical requirements for the two tiers of TSMFs.

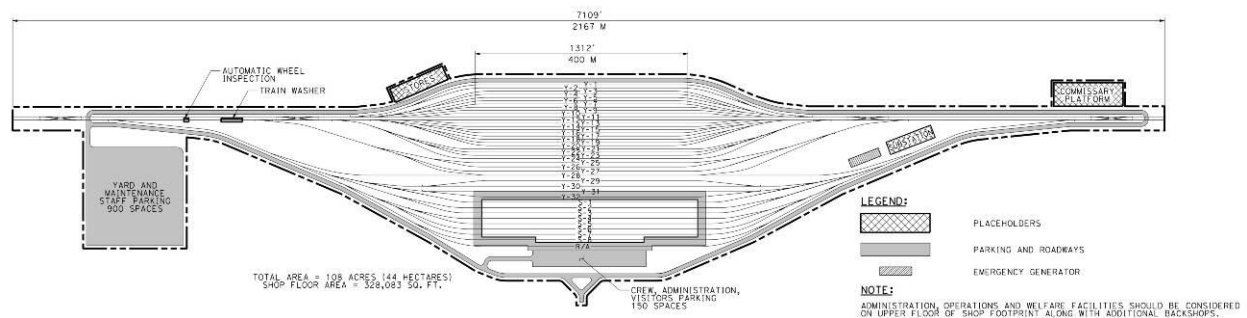
**Table 3 – Terminal Storage and Maintenance Facility Requirements**

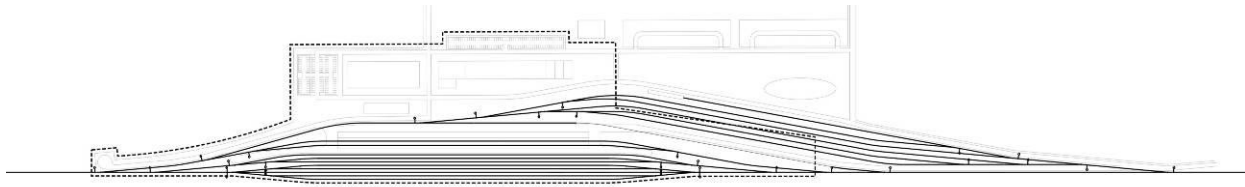
Maint. Levels	Yard Tracks	Servicing / Shop Tracks	Morning Train Starts at Highest Volume	Est. TSMF Length (not including transition tracks)	Est. TSMF Width (at widest point)	Estimated Acreage
II	8	2	15 (B2B for Gilroy)	4000' +/-	785' +/-	42 +/-
III	10-15	8	19 (B2B for SFV)	7500' +/-	1100' +/-	100 +/-

Daily servicing, and monthly and quarterly inspections and maintenance will be made utilizing inside shop tracks with interior access and inspection pits for underside and bogie inspections. San Francisco and San Fernando TSMFs will include facilities with up to 8 servicing/shop tracks while Gilroy and Palmdale will include only 2 servicing/shop tracks each.

Like the HMF, the layout of the TSMF in relation to the main tracks will have a significant effect on TSMF functionality and the flow of trains on the main tracks. The recommended TSMF configuration includes direct main track access achieved through double-ended yard leads to facilitate movements both north and south without changing direction, grade separated flyovers to access the main track opposite the TSMF without affecting main track traffic, 60 MPH interlockings including universal crossovers (approximately 1000 feet long, these must be located in tangent sections, preferred to be at-grade and on relatively level gradient), and 1700 foot transition tracks to reduce speed to/from stop and transition the automatic train control system. Figure 3 shows the conceptual layout and sizing for the 15-track TSMF facility in San Fernando. Figure 4 shows the conceptual layout and sizing for the smaller TSMF facilities (Gilroy and Palmdale).

**Figure 3 – TSMF Concept Plan for San Fernando**



**Figure 4 – TSMF Concept Plan for Gilroy and Palmdale**

Less optimal configurations may include at-grade or “flat” interlockings, turnout speeds in interlockings of less than 60 MPH, and shorter transition tracks. Solutions to these conditions may include additional deadhead miles or time in order to avoid delays to revenue trains by non-revenue movements, additional operating crews in order to expedite reverse movements on the main track, and alterations to maintenance scheduling to accommodate the arrival of non-revenue trains at non-peak hours of operation. The operational and cost impacts of these less optimal configurations must be analyzed to evaluate the trade-off of the increased annual O&M costs versus the increased capital cost and the potential increase in the environmental impacts.

Other O&M facilities that could be co-located with the TSMF include a Maintenance of Infrastructure Facility and, if required, a Regional Control Centers for San Francisco and San Fernando Valley. Locating these facilities as an integral part of, or adjacent to, the TSMF could facilitate better coordination and utilization of operations systems and assets, while also potentially reducing the overall footprint required for the facilities. Locating these facilities away from the HMF will not necessarily introduce negative impacts that could not be effectively managed/mitigated. The individual requirements for these facilities will be discussed in further detail in Sections 2.3 and 2.5 of this memo.

## 2.3 MAINTENANCE OF INFRASTRUCTURE FACILITIES

The CHST infrastructure will be maintained from regional Maintenance of Infrastructure Facilities (MOIF) located at approximately 150 mile intervals. The MOIF will be sized and outfitted to support the maintenance of infrastructure requirements for 75 miles in either direction, supported by a Maintenance of Infrastructure Siding (discussed later) within each 75 mile segment. The 150-mile territory covered by each MOIF accommodates the time for equipment traveling at 60 mph to reach locations along the alignment during the five hour non-revenue maintenance period. Resources will be assigned according to the specific needs of the adjacent territory (for example, the Palmdale MOIF will support maintenance activities for tunnels and high-viaducts that will not be the responsibility of the Fresno MOIF).

The MOIFs will be the locations of regional maintenance machinery servicing storage, materials storage, personnel, and maintenance and administration.

Functional requirements of the MOIF sites include:

- 6 yard tracks plus one siding track (1600'), approximately 28 acres.
- Approximately 8150 feet of yard track capacity.
- Shop facilities for the following activities: MOI inventory, infrastructure and equipment maintenance/repair.
- Stockpile areas for ballast and other bulk materials.
- Secured stockpile areas for non-bulk materials.
- Rail side unloading dock and CWR train storage (1600').
- Rail-borne equipment and locomotive storage tracks.

Main track access is accomplished through 45 MPH turnouts at both ends, ideally located near universal crossover locations (110 MPH) to facilitate efficient movement to either main track.

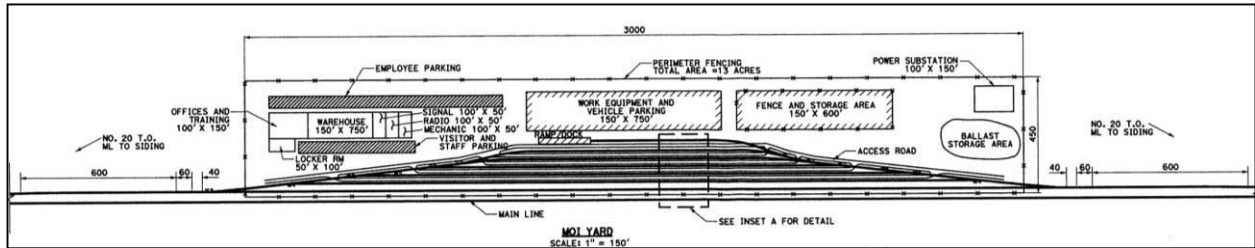


The MOIFs could be co-located with the nearest HMF or TSMF in order to consolidate CHSTS resources and minimize community impacts. Projected MOIF locations include:

- IOS – Fresno, Shafter, Palmdale
- B2B - Gilroy, Fresno, Shafter, Palmdale, San Fernando
- P1B Service – Same as Bay to Basin, depending on maintenance responsibilities for CHSTS in the Caltrain San Jose-San Francisco corridor.

Also required is effective connectivity to the public road network and access to utilities including water, gas, electricity, sewer and communications. MOIF facilities are estimated to be approximately 28 acres in size, inclusive of roadways and parking. Figure 4 shows the conceptual layout and sizing for the MOIF.

**Figure 4 – Maintenance of Infrastructure Facility Concept Plan**



## 2.4 MAINTENANCE OF INFRASTRUCTURE SIDINGS

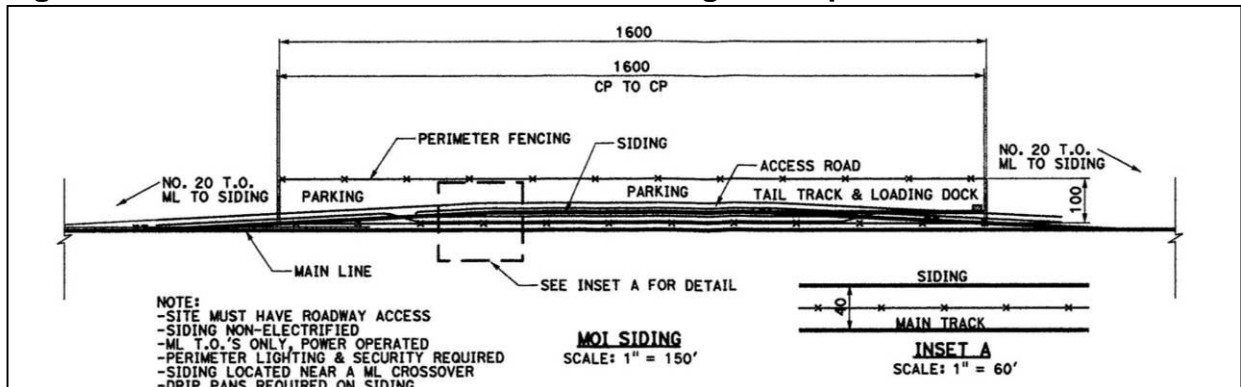
Maintenance of Infrastructure Sidings (MOIS) will be centrally located within the 75 mile maintenance sections on either side of each MOIF. The purpose of the MOIS facilities is to support the MOIF activities by providing a location for layover of maintenance of infrastructure equipment and temporary storage of materials and other resources needed in the adjacent section. The goal is to reduce travel time required to arrive at the maintenance location, thereby enhancing the efficiency and productivity of the maintenance activities.

Functional requirements of the MOIS sites include:

- One siding track (1600 feet)
- Approximately 800 feet of siding track capacity inside the security perimeter.
- One tail track (200 feet).
- Stockpile areas for ballast and other bulk materials.
- Secured stockpile areas for non-bulk materials.

MOIS facilities are estimated to be approximately 4 acres in size. Figure 5 shows the conceptual layout and sizing for the MOIS.

**Figure 5 – Maintenance of Infrastructure Siding Concept Plan**



Main track access is accomplished through 45 MPH turnouts at both ends, ideally located near universal crossover locations to facilitate efficient movement to either main track. More than one location may be required in some MOI territories as a result of difficult terrain such as in the Tehachapi Mountains.

Indicative MOIS locations include:

- IOS – Hanford
- B2B – Los Banos, Hanford, Tehachapi/Rosamond, Sylmar
- P1B – Los Banos, Hanford, Tehachapi/Rosamond, Sylmar, Glendale, and Redwood City (dependent on maintenance responsibilities on the Caltrain corridor)

## 2.5 OPERATIONS CONTROL CENTER

The CHST System will be managed through a centralized Operations Control Center (OCC). Activities include:

- Train dispatch for the entire CHST System, except those areas dispatched by the host railroad in a shared-use corridor operation (Caltrain) or terminal facilities dispatched by a Regional Control Center during Phase 1 Blended Service;
- Management of train control, traction power, and other related systems such as access-control, intrusion detection, and seismic monitoring;
- Fleet management and equipment resource utilization;
- Managing the communications and the flow of information to the passengers, employees, emergency responders, and the communities;
- Crew management for the CHST System;
- System security with coordination of security with local law enforcement agencies, and other emergency responders;
- Emergency response and coordination;
- Maintenance of Infrastructure management and coordination with train dispatch functions;
- Employee training; and
- Train scheduling.

The optimal operational location for the OCC facility is co-located with the HMF, central to the CHST System. This will allow for centralized management of all O&M functions, allowing for maximized asset utilization and greater cooperation across functional boundaries. Locating the OCC away from the HMF is technologically feasible but could create challenges for consolidation of management activities.

## 2.6 REGIONAL CONTROL CENTERS

Located near the end terminals of San Francisco and Los Angeles during the Phase1 Blended Service phase of operations the Regional Control Centers (RCC) could, if required, provide localized management of operations functions in support of the Operations Control Center. Activities include:

- Train dispatch and coordination with local host railroads and connecting transit services;
- Coordination of train movements with TSMF yard management;
- Management of train control, traction power, and other related systems such as access-control, intrusion detection, and seismic monitoring for the local area;
- System security with coordination of security with the Authority's designated police force, local law enforcement agencies, and other emergency responders;
- Emergency response and coordination; and
- Backup control center capability in the event that the Operations Control Center is disabled.

RCC facilities could be located as part of the nearest TSMF, or could be located within the Station building.



### 3.0 ROADWAY ACCESS AND PARKING

The conceptual layout of the roadways and parking areas needed to support the O&M Facilities was developed based on the following assumptions:

#### Access and Circulation

- Access/egress primarily controlled at a single gated entry point
- A two-way circulation road, 24 feet wide, would follow the interior perimeter of each facility
- Roadways to provide access to specific locations in the building(s) and yard(s) would be considered, as shown on the conceptual schematics
- For the HMF and TSMFs, a 50-foot wide asphalt “apron” would surround the main shop building to provide access for emergency vehicles to any point around the structure
- For the HMF, a pedestrian “bridge” over the train yard tracks would be used to connect the employees’ parking lot on one side of the yard tracks and the main shop building on the other side should the design result in the need to cross active tracks

#### Parking:

- At the HMF, up to 275 employees are estimated to be accommodated during “peak shifts”, including consideration of overlapping departure and arrivals of personnel. It is assumed that approximately twenty percent of employees would use public transportation or will ride share, resulting in an eighty percent automobile mode share for employee work trips. The public transportation share would be employees commuting via bus or other local/regional alternatives.
- It is estimated that the parking demand for HMF employees would require space for approximately 220 vehicles based on the estimate of eighty percent automobile mode share ( $275 \times 80\% = 220$ ).

### 4.0 ENVIRONMENTAL CONSIDERATIONS

Impacts to the natural, physical and human environment must be addressed in the development of criteria for locating of O&M facilities. A fatal-flaw level of analysis should include, but not be limited to, the identification of impacts from the siting of O&M facilities to:

- Potential relocation of residences and businesses
- Relocations or displacements of key economic generators
- State and Federal waters
- Historic, archeological and cultural resources (such as those protected un Section 4(f) and Section 106)
- Areas of known biological habitats or other sensitive protected lands
- Compatibility with adjacent land uses

In addition, to ensure a satisfactory range of alternatives under State and Federal law, multiple site alternatives for the HMF and TSMF sites should be developed and fully analyzed in project-level EIR/EIS documents. MOIF and MOIS sites should be located appropriately and analyzed as part of each corridor alternative.



## 5.0 COMMERCIAL CONSIDERATIONS

The HMF, TSMF, MOIF, OCC, RCC, and other facilities will have specific commercial and personnel requirements for operations. The areas where these facilities will be located will need to be able to provide the labor forces to staff the facilities and the programs to train them and/or the services to attract skilled employees from other areas to move to these locations. The following are approximate personnel needs for each of the facilities:

**Table 4 – Approximate Facility Personnel Needs**

Facility	Approximate Personnel Needs (at each facility)
HMF	~275
TSMF	100 - 250
MOIF	~180
OCC	~75
RCC	~60

These employees would need to have the requisite training to perform their functions. For some positions, there are already qualified personnel in California and in the Central Valley but for other functions (for example maintenance of signaling systems, OCS), new training programs will have to be developed and skilled employees from other parts of the country will need to be attracted to the area.

For the higher skilled positions, training programs will need to be developed and can potentially be housed at some of the many Central Valley colleges and universities such as CSU Bakersfield, CSU Fresno, CSU Stanislaus, UC Merced, the community colleges in the area, and other public and private colleges. Other positions may require apprenticeship and qualification programs through the various craft unions. As operation of these facilities approaches, the exact needs of the system will become clearer and the training and hiring programs can be customized for the system and be housed at appropriate locations.

The location of each facility will also require that there is sufficient and appropriate housing and other services available to attract skilled employees from other areas and provide opportunities for local employees.

## 6.0 "OTHER" REQUIREMENTS

In addition to the items that are described above and depicted on the concept schematics, there are other requirements that will have to be provided to support the operation of these TSMF and HMF Facilities:

- Connectivity provision for the Facilities roadways (as shown on the schematics) to the local road and highway network providing access/egress for (examples):
  1. Employees commuting by automobile
  2. Convenient access to public transportation
  3. Deliveries of materials and supplies (using heavy trucks)
  4. Emergency response personnel such as the fire department and medical teams
- Connectivity provision to the electric power grid to power the buildings, shops and trains. These facilities are currently described at a concept level and the requirements will be clarified as design progresses.



- For the HMF, it is desirable to build a sub-station within the “compound” that would support power needs for:
  1. Train storage
  2. Train movements
  3. Test Siding
  4. HMF shops’ operations
  5. Other HMF buildings and facilities
- For the HMF, it is expected that this approach would require a new utility service from the nearest utility distribution line. In this case, it is estimated that ~13.8kV lines would not be sufficient and that a ~34.5kV service into a split step down facility is preferred. The catenary would be (isolated from the main line) supplied by a standard 1x25kV transformer, and the HMF would be fed from standard transformers which could distribute 480v 3ph throughout the facility
- Connectivity to the water system, and both storm and sanitary sewer systems for personnel and industrial purposes. These facilities will provide train washing and toilet servicing for the rolling stock fleet. Water supply would also be required for employee locker room/bathroom facilities, interior building maintenance activities, and commercial food services needs.
- Consideration for refuse removal services
- Zoning for heavy industrial

## 7.0 FACILITIES SITE LOCATION CRITERIA

### 7.1 HEAVY MAINTENANCE FACILITY

It is desirable that the HMF is located centrally on the CHST System between Merced and Bakersfield and, as previously described in Section 2.1 be able to provide direct connection to the main track for testing, acceptance and commissioning of the new CHST fleet. The required length of this test track is based upon current high-speed train manufacturers’ recommendations for testing and commissioning which includes a protocol for sustained running for ten minutes at up to 250 mph.

The rationale for locating the HMF between Merced and Bakersfield is directly associated with international high-speed train best practices and experience obtained from the start-up and implementation of other high-speed train systems. It was determined that it is critical for the HMF to be activated prior to delivery of new train-sets for purposes of (potential) assembly and to have the functional requirements of the facility available during the required testing, acceptance and commissioning of the fleet. The testing procedures require that each train achieve a test speed greater than the in-revenue-service operating speed; for the CHST System that speed range is between 223 mph (minimum) and 242 mph (recommended/preferred) and that this speed be sustained for a duration of ten minutes for each test run. Consequently, in order to provide track infrastructure capable of meeting these requirements, the maximum operating track speed must be 223 mph / 242 mph and the length of the “test track” must be between 79 miles (for 223 mph scenario) and 104 miles (for 242 mph scenario).

In addition, high-speed train international industry best practice recommends that the test track be fully “commissioned and tested” main track to replicate actual operating conditions. Based on these criteria, the Merced to Bakersfield segment conforms to the maximum test speed and track length requirements; other CHST System sections contain civil speed restrictions due to gradient, curvature, or shared-use with other operators (San Francisco to San Jose segment).



A more detailed discussion of the standard testing, acceptance and commission procedures for high-speed train sets is presented in Technical Memorandum 5.1; *Terminal and Heavy Maintenance Facility Guidelines* dated August 2009.

## 7.2 TERMINAL STORAGE AND MAINTENANCE FACILITIES

In addition to proximity and connectivity to the CHST System main line tracks, the site of the TSMF should be such that the distance to the nearest Terminal Station is minimized. While the challenges of placing the TSMF in an urban environment are acknowledged, the long-term impacts of placing the TSMF further from the terminal station that it supports creates O&M inefficiencies that must be included in the overall evaluation of the TSMF site. Increasing the deadhead mileage from the TSMF to the terminal station results in increased costs associated with operating crews (as a function of time and efficiency), equipment operating costs (electricity to power the trains), equipment maintenance costs, fleet size (more trains are needed to support the same amount of revenue mileage), track capacity (more resources such as crossovers, passing tracks or even third main tracks may be needed to support the same amount of revenue service with increased deadhead moves), decreased track/systems life cycle, reduced track/systems maintenance windows, and environmental considerations such as increased resource consumption resulting from the greater distance from the metropolitan area and community impacts resulting from increased train traffic and extended hours of operation.



May 1, 2013

PMT-CHSRA-03185

Frank Vacca  
Chief Program Manager  
California High-Speed Rail Authority  
770 L Street, Suite 800  
Sacramento, CA 95814

RE: Request for Authority review and concurrence

Mr. Vacca,

The Summary of Requirements for Operations and Maintenance (O&M) Facilities is attached for your review. It is understood that this is a living document and will be updated as required. If this meets with your requirements, please sign below acknowledging your concurrence for adoption and use on the program.

Regards,



Brent Felker, P.E.  
Program Director

California High-Speed Rail Authority  
Concurrence



Date: 6/3/2013

Enclosure: Summary of Requirements for O&M Facilities

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